remote from that to which the top has fallen" (see my former letter). If this is the case, it would be strong proof that the explosion actually took place in the core. I shall probably have no opportunity of visiting the spot again for many months.

My recollection is that there are no trees within several feet of the line joining the two damaged ones, which stood in what now looks like an opening in the wood. Mr. Pickering can perhaps check this also.
A. F. GRIFFITH.

15 Buckingham Place, Brighton.

IN several letters lately published in NATURE, an explosion in or by a tree trunk is mentioned. Such an explosion occurred here during the great storm of July 12 last. The lightning struck an old crab-tree, at the base of the trunk, and exactly at the ground-line. The crab was growing on the top of a grassy bank. The lightning tore the bank open from top to bottom, tore open and splintered the roots of the crab, and threw pieces of roots and turf, all in one direction, for 21 feet; the turf was in large pieces, of about a foot cube.

A tiled barn near here was, at the same time, struck in a peculiar manner. The lightning struck the upper tiles near a gable; one tile was torn out and hurled away, and several other tiles were neatly perforated with round holes, each about ¼ inch in diameter; the tiles were red, and the holes were burnt grey all round. The wooden pegs belonging to the perforated tiles were blackened by the heat.
W. G. S.

Dunstable.

On the Remarkable Form of Hailstones.

WITH reference to the description given in NATURE (vol. xl. pp. 151 and 272) of the hailstorm at Liverpool, it will probably be interesting to bring under notice an early account of the remarkable forms often possessed by hailstones; it is to be found in the *Edinburgh Philosophical Journal* for 1824, vol. xi. p. 326. The writer of the said article states that "in the second part of the eleventh volume of the 'Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldinæ Carolinæ Naturæ Curiosorum,' Dr. Nögerath informs us, that, on May 7, 1822, a tremendous hail-shower fell in and around Bonn. . . . The general size of the hailstones was about one inch and a half in diameter, with a weight of nearly 300 grains. When whole, which was not generally the case, the general outline was elliptical or compressed globular, and the form *cerebral*, or resembling the brain of a warm-blooded animal. . . . More frequently the form was lenticular, and appeared polished on the two ends, as if by friction. The masses had a concentric lamellar structure; in the centre was a white, nearly opaque, nucleus, of a round or elliptical form, around which were arranged concentric layers, which increased in translucency from the innermost to the outermost. They at the same time exhibited a beautiful stellular fibrous arrangement, caused by rows of air-bubbles disposed in radii. . . . Captain Delcross, in the thirteenth volume of the 'Bibliothèque Universelle,' describes hailstones having the concentric lamellar structure and stellular fibrous arrangement. . . . The surface was provided with pyramidal forms. . . . When the edges and the angles of the pyramids are melted down, the *cerebral* form is produced; when the masses of hail, having the structures described, burst asunder, the fragments have a pyramidal form, and then forms what has been described under the name of *pyramidal hail.*" The writer then proceeds to describe hailstones which fell on June 27, 1823, at Aberdeen. "They (the hailstones) were included, almost universally, each by five sides or surfaces, four plane, constituting the sides of an irregular pyramid, and one spherical in place of a base. . . . The spherical surface appeared, to the depth of one-twentieth or one-thirtieth of an inch, to be solid as it was transparent. The rest of the hailstone was opaque, consisting of crystals or minute columnar forms, perpendicular to the spherical surface." Eight figures, illustrative of the different kinds of hailstones, are given (Plate ix.).

Miss Holt refers to the metallic taste and the flavour of ozone possessed by those which fell at Liverpool. The presence of NH_3 in hailstones was long ago established by Mène (*Comptes rendus*, May 19, 1851).
J. SHEARSON HYLAND.

14 Hume Street, Dublin.

Erinus hispanicus (?) on the Roman Wall.

THE accompanying note on this alien Scrophulariaceous plant will, I think, be of interest to many of your readers, more especially to those who, as members of the British Association, took part in the excursion on Thursday last from Newcastle to the Roman Wall.

The plant occurs on some Roman remains at Chesters, Chollerford, Northumberland, the residence of Mr. John Clayton. In the recent editions of Dr. Bruce's "Hand-book to the Roman Wall," it is named *Erinus hispanicus*, but it appears to have been previously known as *E. alpinus*. In endeavouring to determine its authoritative name, I have ascertained that the plant was called *E. hispanicus* by Persoon ("Synopsis"), who regarded it as a doubtful species, whereas all other authors regard it as a variety of *E. alpinus*. There is a specimen, apparently of this plant, in the Oxford Herbarium, collected by Endress ("Plantæ Pyrenaicæ exsiccatæ, Annis 1829–30 lectæ") which he calls *E. alpinus*, var. *lanuginosus*; Grenier and Godron ("Flore Française") call it *E. alpinus*, var. *hirsutus*; Lange calls it *E. alpinus*, var. *villosus*; and Willkomm and Lange, in their "Flora Hispanica," follow Grenier and Godron, giving the other names as synonyms. It will doubtless be best to accept Willkomm and Lange's conclusion, and adopt the name *E. alpinus*, var. *hirsutus*, Grenier et Godron.

I may add that *E. alpinus*, L., is mentioned, in Babington's "Manual of British Botany," as occurring near Tanfield, in Yorkshire, a locality which is also given in the last edition of Hayward's "Botanist's Pocket-Book." However, in Arnold Lees's "Flora of West Yorkshire" (1888), it is stated that this plant has disappeared from Tanfield. Consequently Chesters is now the only English locality for *Erinus*, and the only form is the var. *hirsutus*.
SYDNEY H. VINES.

Oxford, September 23.

Noctilucous Clouds.

THE recent communications in NATURE in relation to apparently self-luminous cloud-like bands in the skies after nightfall, call to mind the analogous phenomena of noctilucous clouds involving the whole visible firmament.

We are indebted to the indefatigable industry and zeal of the illustrious Arago for the collection of the scattered facts relating to the phenomena of self-luminous clouds of divers kinds.[1] According to the records collected by him, noctilucous bands and zones of clouds are sometimes associated with the electrical manifestations accompanying distant thunderstorms. To this class belong the luminous phenomena noticed by Rozier on August 15, 1781, and by Nicholson on July 30, 1797. In other cases, the association of the phenomena with electrical disturbances, is by no means obvious. To this class belong the luminous clouds observed by Beccaria over his observatory at Turin; likewise the luminous appearances witnessed by Deluc near London, and also those observed by Major Sabine over the Isle of Skye in Scotland. In all these cases, the noctilucous condition of the clouds was localized and confined to bands or zones in limited portions of the sky. But under certain conditions this apparently self-luminous property of the nocturnal clouds involves the entire visible hemisphere. It is to this latter aspect of the noctilucous phenomena that I desire to call attention.

Omitting the consideration of the exceptionally rare and anomalous phenomena of so-called phosphorescent "dry-fogs," as those of 1783 and 1831, in which the luminosity was so pronounced as to enable one to read ordinary print at midnight, we come at once to the generally recognized phenomenon of that faint diffused cloud-luminosity which enables the "country doctor," with comparative security, to perform his lonely midnight drives on cloudy moonless nights. Frequently the glow is so faint that it is only possible to observe it at a distance from cities and large towns, in places where the air is free from smoke, and where the darkness of the sky is not affected by the general illumination due to gas and electric lights.

The conditions under which the phenomena most conspicuously manifested themselves to my observations were during the incipient stages of the autumnal north-east storms occurring

---

[1] *Annuaire du Bureau des Longitudes pour l'An* 1832, pp. 246–50; *ibid.*, 1838, pp. 279–85. "Œuvres Complètes de Arago," vol. iv. pp. 70–77. Arago's "Meteorological Essays," translated by Sabine, pp. 48–53 (London, 1855).

© 1889 Nature Publishing Group

near the sea-coast of Georgia (U.S.A.). In these three-days cyclonic storms, before the rain begins and usually before the lowest strata of air are sensibly disturbed by the upper currents, the low-lying dense masses of clouds coming from the north-east scud across the skies with great rapidity. Under these circumstances, during moonless nights, the general illumination is sufficient to plainly indicate the road to the traveller, even when it is bordered by tall overhanging trees. Under ordinary circumstances, an equivalent degree of cloudiness would have compelled the traveller to abandon all attempts at guiding the horse, and to rely entirely upon the superior acuteness of the nocturnal vision of his equine companion. In such storms, the cloudiness involves the entire firmament, and there are no electrical manifestations. To the traveller, the general illumination apparently surpasses that of a starlight cloudless night.

Now the question is, What is the origin and source of this general nocturnal illumination on cloudy moonless nights? No degree of cloudiness seems to completely obliterate the faint illumination. For, as Arago intimates, even when the heavens are overcast, during moonless nights, and the stars are hidden by an unbroken mass of the most dense clouds, there is a sufficiency of diffused light in the open country to prevent the difficulty and inconvenience which would attend any attempt to walk in the Cimmerian darkness of a cavern.

It is a popular opinion that the clouds act like ground-glass lamp-shades in diffusing the aggregate starlight, so as to produce a faint illumination from all parts of the sky, and thus obliterating shadows on the surface of the earth due to the greater amount of light radiated from the more luminous regions of the celestial vault. But Arago justly maintains that when we consider the immense effect of clouds in weakening the dazzling light of the sun on particular days in winter, it is scarcely possible to admit that the faint diffused light, which, on a cloudy night, guides the steps of the traveller, comes from the stars. In other terms, in view of the loss from reflection and absorption, the amount of starlight penetrating the cloud-canopy seems to be quite inadequate to account for the degree of general illumination observed at the surface of the earth. If we exclude the stellar origin, there remains no other explanation of the nocturnal light of a clouded sky, except the admission that the clouds themselves have a luminosity of their own. This is the view taken by Arago.

But since, for all degrees of obscuration, more or less of the starlight incident upon the canopy of clouds must penetrate it, and be diffused at the surface of the earth, this source of luminosity must be looked upon as a *vera causa.* Its adequacy to explain the observed illumination in any given case will depend upon the density of the overcasting cloudy masses and upon the sensitiveness of the human organ of vision. Hence it seems to be more rational to conclude that some portion of the nocturnal luminosity of clouds may be due to the faint diffused starlight; but that, when the amount of illumination from comparatively dense noctilucous clouds surpasses that of clear moonless nights, we are warranted in assigning them self-luminous properties. This seems to have been the condition of the low, dense, and rapidly-drifting clouds observed by me during the incipient stages of north-east storms on the Atlantic coast. Moreover, the fact that an equal degree of cloudiness is not always attended with an equal amount of illumination points to the same conclusion. In other words, it seems to be reasonable that the degree of luminosity sometimes manifested in the deep winter nights, when the whole heavens are overcast with dense clouds, is vastly too great to be due to diffused stellar light, and is more probably ascribable to the greater or less self-luminous properties of the clouds themselves.

In the case of isolated clouds, augmented nocturnal brightness may be due to well-known local causes, independent of self-luminosity. For example, the source of the brightness of the clouds observed by Prof. Piazzi Smyth in 1882 and 1883, was traced by him to the reflection of the gas-lights of the city of Edinburgh, from water-drops in the clouds (NATURE, vol. xxviii. p. 239). In like manner, the bright nocturnal clouds observed by Mr. T. W. Backhouse and others in 1886 (NATURE, vol. xxxiv. pp. 239, 312, 386) were probably due to bands of lofty clouds illuminated by the lingering sunlight.

But even in cases in which the noctilucous condition of the clouds is general, it is more than possible that the starlight illumination may be reinforced by the prolonged twilights due to the reflection of sunlight from attenuated solid particles suspended in the supra-cirrus strata of the atmosphere, such as were manifested after the Krakatão eruption in the autumn of 1883. Moreover, in certain cases the stellar illumination may be strongly augmented by cloud-obscured auroral lights. These several possible sources of extra-stellar illumination of the sky during cloudy nights seem almost to preclude the necessity of the assumption of the existence of the condition of self-luminosity of clouds under any circumstances.

But, admitting the occasional self-luminous condition of clouds, the question is, What are the physical causes of their luminosity? It is customary to refer such obscure luminous phenomena to phosphorescence or to electricity. But it must be confessed that, in the absence of definite knowledge of the physical causes of the phosphorescence of clouds, on the one hand, or of distinct electrical manifestations in such clouds, on the other, such explanations, so far from enlightening us, would seem to be more akin to illustrating the obvious by the obscure.

Seafaring men must have had numerous opportunities of observing noctilucous clouds in various latitudes under every degree of obscuration; but I do not, at present, recollect any reference to such observations on the ocean. In "The Voyage of H.M.S. *Challenger*," in the "Memorandum of Meteorological Observations," under head "Weather," there is a record of the "visibility of distant objects"; but I have been unable to find any night-observations of visibility ("Narrative," vol. ii. p. 300 *et seq.*).

Berkeley, California, August 30. JOHN LE CONTE.

ON BOSCOVICH'S THEORY.[1]

WITHOUT accepting Boscovich's fundamental doctrine that the ultimate atoms of matter are points endowed each with inertia and with mutual attractions or repulsions dependent on mutual distances, and that all the properties of matter are due to equilibrium of these forces, and to motions, or changes of motion produced by them when they are not balanced; we can learn something towards an understanding of the real molecular structure of matter, and of some of its thermodynamic properties, by consideration of the statical and kinetic problems which it suggests. Hooke's exhibition of the forms of crystals by piles of globes, Naviers's and Poisson's theory of the elasticity of solids, Maxwell's and Clausius's work in the kinetic theory of gases, and Tait's more recent work on the same subject—all developments of Boscovich's theory pure and simple—amply justify this statement.

Boscovich made it an essential in his theory that at the smallest distances there is repulsion, and at greater distances attraction; ending with infinite repulsion at infinitely small distance, and with attraction according to Newtonian law for all distances for which this law has been proved. He suggested numerous transitions from attraction to repulsion, which he illustrated graphically by a curve—the celebrated Boscovich curve—to explain cohesion, mutual pressure between bodies in contact, chemical affinity, and all possible properties of matter—except heat, which he regarded as a sulphureous essence or virtue. It seems now wonderful that, after so clearly stating his fundamental postulate which included inertia, he did not see inter-molecular motion as a necessary consequence of it, and so discover the kinetic theory of heat for solids, liquids, and gases; and that he only *used* his inertia of the atoms to explain the known phenomena of the inertia of palpable masses, or assemblages of very large numbers of atoms.

It is also wonderful how much towards explaining the crystallography and elasticity of solids, and the thermo-elastic properties of solids, liquids, and gases, we find without assuming more than one transition from attraction to repulsion. Suppose, for instance, the mutual force between two atoms to be repulsive when the distance between them is $< Z$; zero when it is $= Z$; and attractive when it is $> Z$: and consider the equilibrium of groups of atoms under these conditions.

---

[1] Abstract by the Author of a communication to Section A of the British Association, on Friday, September 13, at Newcastle.

© 1889 Nature Publishing Group